Small Business Innovation Research/Small Business Tech Transfer

Properties Investigation of High-MON Oxidizers for Use in Deep Space Exploration, Phase I

Completed Technology Project (2018 - 2019)

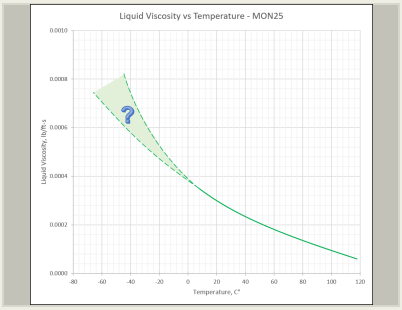
Project Introduction

Rocket propulsion for deep space applications typically use liquid propellants for axial stage and attitude control systems. The most common propellants are hydrazine (N2H4) and monomethylhydrazine (MMH) (CH3N2H3) for the fuels, and nitrogen tetroxide (NTO) (N2O4) for the oxidizer. The freezing points of both hydrazine and NTO approach room temperature and require on-board electrical heaters for the propellant tanks. MMH has a much lower freezing point but is used with NTO as an oxidizer so propulsion systems still require significant heater power. MON-25, an oxidizer composed of NTO mixed with 25% nitric oxide (NO), has a freezing point comparable to MMH. MMH and MON-25 propellants can allow a thruster to operate at -40°C. However, the properties of MON-25 have not been fully defined, specifically at temperatures below 5°C . This project will further characterize the properties of MON-25 and MON-30 oxidizers so they can be used with confidence at cold temperatures in space flight systems. These propellants will save considerable power required for propellant heaters, which will permit larger science payload and enhance the mission capability of deep space probes. The low-temperature oxidizers may also find use in lunar landing and ascent systems where sunlight is intermittent or absent.

Anticipated Benefits

Completion of the Phase I program will provide property data needed to reduce risk in current rocket engines under development by both NASA JPL (MON-30 hybrid motor) and Frontier Aerospace/NASA MSFC Deep Space Engines (DSE) using MON-25/MMH. The MON-30 hybrid, a possible Mars ascent motor that burns a solid with the oxidizer, is slated for possible use in the early 2020s. The DSE are ideal for use on future deep space missions for orbit insertion, transfer and landing/ascent propulsions systems.

It is anticipated that the DSE will be used, in the 2020 timeframe, on a commercial lunar lander under development by Astrobotic. Mission success by Astrobotic will bring the DSE to a TRL 9 and provide a low-cost, high performance, high TRL engine to the space transportation market.



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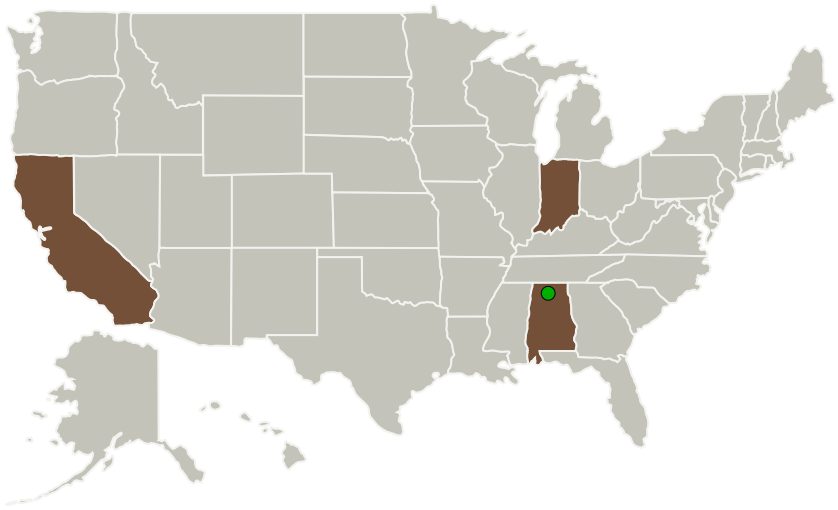
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Frontier Aerospace Corporation	Lead Organization	Industry	Simi Valley, California
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
Purdue University-Main Campus	Supporting Organization	Academia	West Lafayette, Indiana

Primary U.S. Work Locations	
Alabama	California
Indiana	

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Frontier Aerospace Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

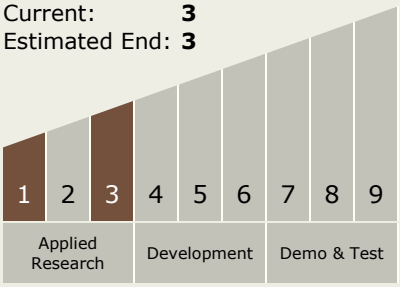
Carlos Torrez

Principal Investigator:

James M Mckinnon

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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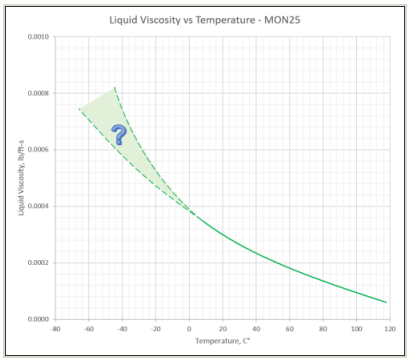
April 2019: Closed out

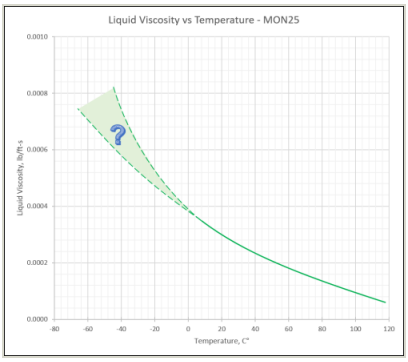
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137887)*

Images



Final Summary Chart Image
Properties Investigation of High-MON Oxidizers for Use in Deep Space Exploration, Phase I *(https://techport.nasa.gov/image/126316)*



Project Image
Properties Investigation of High-MON Oxidizers for Use in Deep Space Exploration, Phase I *(https://techport.nasa.gov/image/129722)*

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.2 Earth Storable

Target Destinations

The Moon, Mars, Others Inside the Solar System